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A NOVEL METHOD FOR IDENTIFICATION OF DEFECTS IN FABRIC

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ABSTRACT

The textile industry is the most economical and competitive industry in the world. This makes the industries to improve the quality of the fabrics. There occur huge amount defects in the fabrics during production. Fault identification and classification is the most important role in the inspection of fabrics. Currently using inspection methods are done manually or by imported machines. But it consumes more time, cost and power. The proposed method is to check the defects in the fabrics to increase the fault free production with low cost and minimum power. In this proposed system, the microcontroller used here is RL78 and it is minimum power consuming one among the other microcontrollers.

KEYWORDS: Fabric Inspection, Fault Identification, RL78 Microcontroller

INTRODUCTION

The textile industry is one of the most important and competitive industry in today's world. The industry should have the necessity to satisfy the customer needs, so they compete with each other to improve the quality of their products. The high quality of the fabric inspection method reduces time consumption. Automatic fabric inspection method replaces manual method for reducing the stress occurs in human inspection. The proposed method of detecting defects in fabric using RL78 microcontroller controls the entire system. The fabric from the machine is scanned step by step by using the sensor. The sensor output logic level decides the presence and absence of the defect. According to the sensor output, the microcontroller is enabled or disabled automatically by programming.

Digital images are the basics for the analysis of the fabric. The system acquires digital fabric images by image acquisition device and converts the image into binary image for processing [1][2]. Reference and test samples are differentiated using the texture features of the fabrics [3][4]. The images of fabric material are captured and processed to detect the defects by comparing with the database of images with no faults [5]. A statistical approach employs Eigen values is one of the method for identifying defect in the fabrics [6]. First order statistical features are extracted from the binary image and given as input to the Artificial Neural Network (ANN)[7][8]. Different measuring mechanisms are used to compare the fabric defect identification techniques [9]. The pre-processed image is decomposed into its binary image to detect the defects information of the location are found by means of weighted morphology [10][11]. The Artificial Neural Network is one of the defect identification model. The input to the artificial neural network is the extracted features and it identifies the defect [12]. Feature extraction is done on every row of the image to make the properties of pixels more accurate [13]. Statistical analysis of the DCT coefficients of the textile pattern images makes the feature extraction and detection of fabric defect faster [14]. Texture-periodicity and the Jensen-Shannon Divergence are the new machine vision algorithm for defect detection automatically [15][16]. All wavelet coefficients were extracted from the fabric to detect defect in fabric and here genetic algorithm is used for finding a suitable subset [17].

VALUE OF MATERIALS

The quality of the fabric depends upon the type of yarn and raw materials used for producing the textile fabrics. The quality of the fabric is reduced due to the change in the nature of the fabric. The change may be missing yarn, additional yarn, color change etc. Additional to this, quality can also be reduced due to long day usage of the weaving machine or change in operating conditions of the system due to climatic changes. The Manufacturer always aims to produce the high quality products within a shorter period of time. The higher the quality of the fabric increases the benefit of the manufacturer from the production. So they need better inspection methods to improve the quality of the fabrics. The weaving process interrupts the testing of fabric and practically difficult in case of larger production. Earlier, the process of identification and classification of defects in fabrics is done manually which detects only smaller defects. This needs some of the automated inspection methods in larger production. To identify the information about the most frequently occurring defects and the most costly defects, data was collected from the leading fabric industries. The most frequently occurring defects are broken picks, harness drops, and start marks. The most costly defects are broken ends, waste and coarse picks [18].

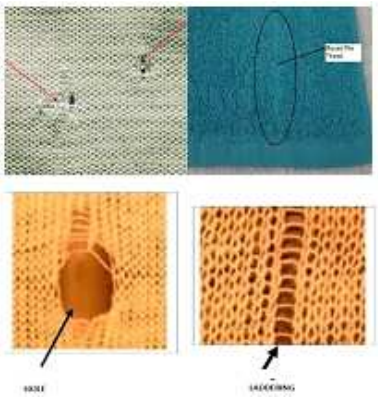

Figure 1: Some of the Defects in Fabrics

A different types of defects based on the various industries. The major classification of defects in a fabric is due to manufacturing [19] and handling. Handling defects occur mainly in silk fabric due to the property of the cloth and poor handling by the human. This defect is mostly not recovered.

FABRIC IMPERFECTION REVIEW METHODS

Conventional Inspection

Traditionally the faults occurs in the fabric is identified by humans manually. This type of continuous inspection makes the person not attentive and tired. Some health conditions such as physical and mental makes the person absent from the working place which may lead to improper inspection [20]. The weaving machine produces the fabric by manual method with lesser width and machine rotating speed. If a human while inspecting the fabric notices a defect on the moving fabric, then the individual needs to stop the motor in which the fabric rotates and registers the defect with its location and again the person needs to start the weaving machine. This type of activity is time consuming.

Automation for Assessment

The automatic fabric inspection method is good due to the reduction in manual work, cost and other associated benefits are considered [21]. This system inspects the fabric by means of bank of cameras arranged in parallel across the

fabric to be scanned. The automated system consists of single or an array of processors, lighting system, frame grabber, and the supporting electrical and mechanical interfaces for the inspection mechanism. The inspection method uses parallel processing of the image using proper algorithm. The speed of image capturing doesn't match with the processing speed. Some of the frames are not processed due to this mis-match in the synchronization. So the result of this fault analysis may or may not be accurate.

MATLAB

A brief overview of the process of MATLAB simulation flow for the fabric inspection is shown in figure 2.

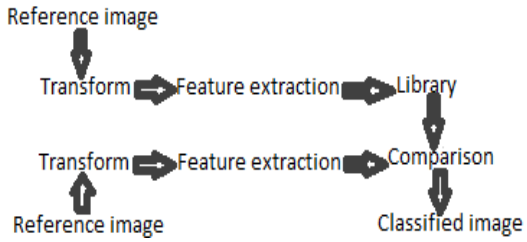

Figure 2: MATLAB Simulation Flow

Initially original non-defective reference samples are collected and their features are extracted using some algorithm and the details are stored in database for comparing with the test sample. Then the test samples which are to be inspected are captured using a digital camera and their features are extracted. This camera is attached to a shaft and moves over the entire sample for inspection and classification. This kind of movement of the shaft is controlled by embedded system which employs a microcontroller. Capturing and extracting features for reference and test sample follow the same procedure. Then the stored features of the reference image and the test sample are compared and analyze the defect using appropriate algorithm. The obtained defect is classified using the database and displayed on the screen [22][23]. Also the same process can be done by using LABVIEW [24].

Fourier Analysis

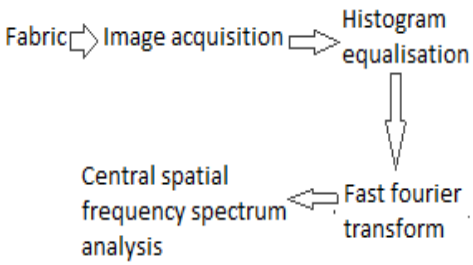

Figure 3: Fourier Analysis Flow Diagram

In Fourier analysis, the defected fabrics are compared with faultless fabric. The fabrics are inspected for various kinds of defects such as double yarn, missing yarn, web and fabric density variation. The system for acquiring image contains a personal computer, frame grabber, Cmos-imager and a system monitor. The Cmos-imager captures the image of the fabrics and a frame grabber converts the video signal into a 768*576 pixel with eight-bit gray level resolution image. Then the result stores in a memory location of computer. The stored data of the image data is processed to detect the defects by some procedures. Histogram equalization is process to get a uniform density image histogram. A Fast Fourier Transform is the fast computation technique, which is used to cut the image size into 512X512 pixels in Fourier analysis of defects in fabrics.

Fuzzy Logic

The fuzzy logic technique identifies and classifies the fabric faults effectively. The fabric video is captured, which is used for quality test inspection. Then the video is divided into individual frames. The preprocessing of the individual frames improves the quality of the image. To analyze the fabric faults, the extraction of textural features those images are important. These textural features are given as the input for the fuzzy system. The faults in the fabrics are identified and they are classified based on the extracted features [25].

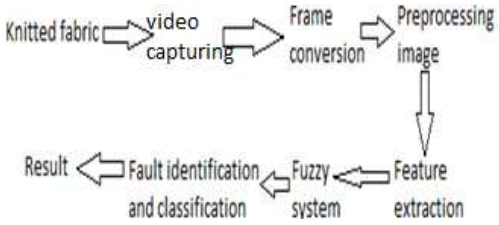

Figure 4: Fuzzy Logic Flow

PROPOSED TECHNIQUE

The main motive for the proposed method is to develop an economical automated fabric defect detection considering the reduction in labor cost and associated benefits. Numerous techniques have been developed to detect fabric defects and the purpose of this paper is to propose a better method when compared to other techniques.

The fabric from the machine is monitored using sensor. If the sensor output is high, then the fabric has defect and the motor is disabled using microcontroller.

The fabric which has the defect will be removed and then the motor is switched on. If the sensor output is low, then the fabric has no defect and then the message is displayed as Fabric has no defect. The sensor used here is thickness sensor to identify the holes in the fabrics. RL78 microcontroller is a low power, high speed controller. It is used to control the whole system.

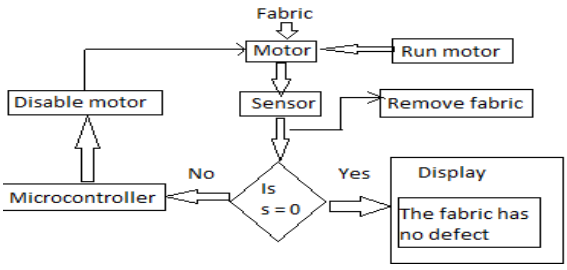

Figure 5: Block Diagram of the Proposed Method

Roller Module

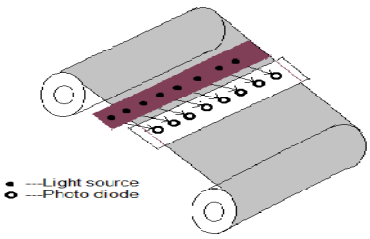

Figure 6: Roller Module

The roller module is used here to move the fabric. This module consists of two stepper motors on two sides, which moves step by step as a pulse. The sensor circuit is placed under the moving fabric and the circuit is fixed in the board in which the motor is fixed. The light source is fixed above the fabric so that the light falls on the sensor circuit. If the fabric has any holes the light directly falls on the sensor circuit and the sensor circuit produces the voltage variation according to the defect. RL78 microcontroller is connected with the roller module. Interrupt from the roller module is given to the microcontroller.

Parallel to Serial Shift Register 74LS165

The shifter used in this method is an 8-bit serial shift register which shifts data in the direction of QA toward QH by giving clock. Eight individual direct data inputs make the parallel-in-access, which are enabled by a low level at the shift/load input. Clock inhibits by holding either of the clock inputs HIGH and other clock input enables by holding either clock input LOW with the load input HIGH. If the clock input is HIGH then only the clock-inhibit input should be changed to the high level only. Whenever the load input is HIGH parallel loading is inhibited. Data is loaded directly at the parallel inputs into the register on a HIGH-to-LOW transition of the shift or load input, without considering the logic levels on the serial inputs, clock or clock inhibit.

RL78 Architecture

RL78 contains CISC based CPU core and 32 general purpose registers. The registers have four banks of register sets and each bank contains eight bit registers. A 16 bit data is handled by register pair formed by combining the 8 bit registers. The register bank is required to select the CPU operation, prior to operation. In order to keep the copy of the contents of selected register bank, remaining register banks are used.

This kind of selection speeds up context switching during interrupt servicing. Control registers support these registers like Stack Pointer (SP), Program Status Word (PSW). A 20 bit Program Counter (PC) indicates the program flow, ES and CS registers contains data and code addresses. To cover both program and data memories, CPU can access up to 1Mbyte of memory space in linear addressing. 512Kbytes of memory is made available for Flash area and 32Kbytes for on chip SRAM. Because of low power operations, the flash memory can also be modified with the minimum voltage of 1.8V. In order to speed up signal processing operations, the CPU core contains a Multiplier unit, Divider unit or MAC along with shifting facilities. RL78 family has many packages and various pins ranging from 20 pins to 128 pins available for different applications.

RESULTS AND DISCUSSIONS

The parallel to serial shift register (LS165) which was used to shift data serially. The parallel input to shift register was taken from the sensor circuit which uses photodiode. The RL78 microcontroller was employed to control the shift register by giving the clock. Then the data was shifted and then the result was displayed on the screen as “The fabric has defect or not” using LCD display. But in this proposed method only holes or gaps due to missing yarn are identified.

Fuzzy logic is the most accurate method and can be implemented with any system [25]. Although the existing microcontrollers are less accurate than the fuzzy logic, if it is implemented with the proposed RL78 microcontroller further the accuracy will be increased with low power consumption.

CONCLUSIONS

This proposed paper identifies and classifies the defects using sensor circuit and RL78 Microcontroller. RL78 Microcontroller increases the efficiency and the power consumption is reduced with high speed microcontroller. In this proposed system, only the holes present in the fabric are detected. The Scope for the future work is to identify the other defects by using the different sensor circuits such as image sensor to increase the productivity and quality of fabric in industry by implementing fuzzy logic with RL78 microcontroller.

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